

Plant genetics and breeding research: Scientometric profile of selected countries with special reference to India

Dr. Prafulla G. Bansod, Department of Botany, (Vidya Bharati Mahavidyalaya camp Amravati),
India.

Abstract - An examination of 32,574 papers distributed by the USA, UK, China, India and Brazil in the field of 'plant hereditary qualities and reproducing' research during 2005-2009 demonstrates that the USA created the most elevated number of distributions followed by China. The effect of exploration yield as seen by the estimations of various effect markers is most noteworthy for the UK. The sub-areas of accentuation of exploration moved in 2009 when contrasted with 2005 for all nations. India contributed around 9% to the world distribution yield. Indian yield framed a piece of standard science as seen by the example of distribution and reference of the examination yield. The absolute Indian yield started from 1,806 establishments situated in various pieces of the country. Around 41% of the all-out Indian yield was concentrated among 23 organizations. Among the establishments, global foundations situated in India had the most noteworthy effect. The extent of single-created papers has diminished significantly and the portion of universally co-composed papers has remained practically consistent during the time of the study.

Keywords: Plant Genetics, breeding, scientometric, mutation and climate change.

I. INTRODUCTION

Farming is fundamental to the economies of most agricultural nations, as it addresses the methods for work of a considerable extent of their populace. In India alone, almost 650 million individuals are reliant on agribusiness or related exercises addressing around two-third of India's populace. Horticulture and united areas contribute almost 25% of Gross Domestic Production (GDP). As indicated by an approach brief by Beintema and others, "India put impressively in its public agrarian exploration framework during the previous twenty years and positioned fourth regarding complete interests in open farming R&D on the planet, following the United States, Japan and China. Public spending in rural R&D in India, in swelling changed terms, developed significantly during 1991–2003 at a normal pace of 6.4 percent each year". Plant hereditary qualities and rearing is one of the significant examination zones in the field of horticultural sciences in India. It uses a huge swath of procedures and systems identified with rearing, cytogenetics, genomics, sub-atomic science, transgenic, tissue culture and so on This includes hereditary qualities and reproducing research on a few products like cereals (rice, wheat, maize and so forth), beats (chickpea, pigeon pea, mung bean, lentil and so on), oilseeds (rapeseed, sunflower and so on), organic product crops, vegetables, flavours, blossoms and numerous mechanical yields. The fundamental design is to advance or create reasonable assortments or ideal genotypes which can out yield the current assortments and is safe/open-minded to biotic and abiotic stresses utilizing

normal or made inconstancy through regular or marker-helped choice or transgenic approach. The examination in this field of information will assist with taking care of well the prospering Indian populace just as gain a substitute the fare market for India.

The flow study presents a scientometric profile of 'plant hereditary qualities and rearing' research in India. It analyzes the overall situation of India opposite other creating and created nations during 2005 – 2009 dependent on information acquired from Web of Science. USA and UK have been taken as agents of created countries, while India, China and Brazil as delegates of developing economies.

Objectives of the study

- To distinguish the example of exploration yield for USA, UK, China, India and Brazil during 2005- 2009;
- To discover the effect of the examination yield of the previously mentioned nations utilizing distinctive bibliometric pointers; &
- To present the move in an accentuation of the sub-areas of exploration for every country in 2009 when contrasted with 2005 utilizing an investigation of the catchphrases.

II. METHODOLOGY

The investigation depends on distribution and reference information downloaded from Thomson Reuters' Web of Science (WoS) data set for the time frame 2005-2009. The records were separated utilising suitable catchphrases in the "Subject" search field of the WoS data set. The catchphrases

were chosen from the substance and record pages of the book 'Standards of Plant Genetics and Breeding'². Addendum 1 records these 126 watchwords. The downloaded information contained data about the author(s), the title of the paper, an alliance of the author(s), the name of the diary where the examination results were distributed, references got by the paper and the watchwords. The downloaded information was changed over into a FoxPro data set utilizing a straightforward FoxPro program. It was needed as the downloaded information required normalization on various factors, similar to the name of the establishment and diary name. Control of information utilizing the 'investigate' order gave in Web of Science (WoS) isn't adequate and real. Downloaded records were separated for the USA, UK, China, India and Brazil. The downloaded information was advanced with the effect factor of the diary and its nation of distribution. The creator catchphrases from these records numbered 4884. A recurrence table for these catchphrases was created. The examination was completed on 198 catchphrases having a recurrence of more than 15. These catchphrases were subsequently ordered into 15 wide non-covering sub-spaces of 'plant hereditary qualities and reproducing' which were utilized for figuring the movement file of five distinct nations for 2005 and 2009 separately.

Bibliometric indicators used

A wide scope of markers are accessible in the writing to evaluate the effect of the examination yield and we have utilized the accompanying pointers:

Number of distributions (P); the quantity of references (C); mean number of references per distribution (CPP); level of distributions not referred to (PNC); sway factor of the diary (IF); and Relative Citation Impact (RCI). Other than these effect pointers, Activity Index (AI) was utilized to analyze the move in accentuation by various nations in various sub-spaces, just as the adjustment in the co- initiation design for India. The quantities of distributions (P) and the references (C) have been straightforwardly acquired from the downloaded information. CPP is the proportion of C/P and has been generally utilized in a scientometric investigation to standardize the enormous divergence in volumes of writing distributed by various nations. The estimations of effect factor for various diaries were acquired from the yearly aggregation of Journal Citation Report (JCR) 2008. RCI is a proportion of both the impact and perceivability of a country's exploration from a worldwide point of view. It is characterized as the proportion of a lot of world references to a lot of world distributions (C %/P %). $RCI = 1$ demonstrates that country's reference rate is equivalent to a world reference rate; $RCI > 1$ shows that country's reference rate is higher than the world's reference rate and $RCI < 1$ demonstrates that country's reference rate is not exactly the world's reference rate.

III. ANALYSIS

The aftereffects of the examination have been partitioned

into two sections. Section one of the outcomes manages the example of yield for the previously mentioned five nations other than analyzing the adjustment in accentuation during 2009 when contrasted with 2005. The second piece of the outcomes presents a scientometric profile of 'plant hereditary qualities and rearing exploration in India. Examination patterns and move in accentuation

The example of examination yields of various nations during 2005-2009

During the time of the study, the USA, UK, China, India and Brazil distributed 32,574 papers. The USA distributed the most elevated number of papers followed by China. Brazil had the most minimal yield (Table 1). Figure 1 shows the example of the yield of five distinct nations during 2005-2009. It shows USA and Brazil followed a practically comparable example of development aside from that there is a lofty decrease in the examination yield of the USA in 2009, while for Brazil, a minimal decrease in the exploration yield has been seen in the year 2009. For the UK, a slight decay has likewise been seen during 2008, while Indian yield is reliably expanding and has balanced out during 2008-2009. China is the solitary country that showed a consistent and steep ascent in the yield during the time frame canvassed in the examination.

Effect of the yield of various nations during 2005- 2009

The distribution yield and the references got by the papers distributed by every country during 2005- 2009 are given in Table 1. It demonstrates that among the five nations the USA created the most noteworthy number of papers, trailed by China. Nonetheless, among every one of the nations, the estimation of CPP and RCI is most noteworthy for UK followed by the USA. For China, India and Brazil, the estimation of CPP, just as for RCI, is not exactly their relating world midpoints, which shows that the papers distributed by these nations are inadequately referred to in the worldwide writing. Notwithstanding, China better-affected exploration yield than India and Brazil as reflected by the estimations of CPP and RCI. A comparative pattern is likewise reflected by the level of papers not referred to in global writing. The level of papers not referred to was most noteworthy for Brazil followed by India and least for the UK.

Action profile of chosen nations in various sub- areas during 2005 and 2009 as the outright yield of distributions is frustrated by the size of the nation just as the size of the claim to fame, Activity Index (AI) first recommended by Frame⁴, and explained by Schubert and Braun⁵ have been utilized. Artificial intelligence describes the relative examination exertion a nation dedicates to a given field and mulls over the impact of the size of the nation just as the size of the field. Artificial intelligence is the proportion of the nation's offer on the planet's distribution yield in the offered field to the nation's offer on the planet's distribution yield in all fields. Ordinarily, AI is determined by utilizing the complete supreme distribution yield. However, in the present study

the values of AI have been calculated by using the total publication output resulted from the use of different keywords for 2005 and 2009.

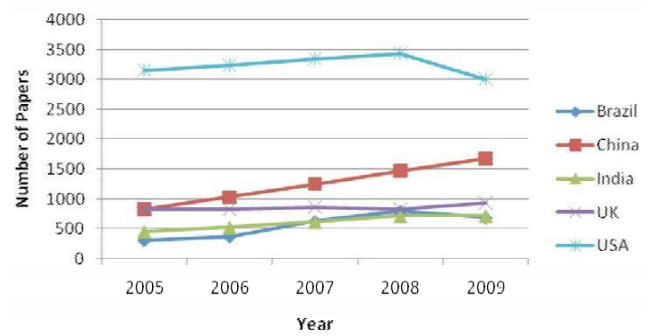


Fig. 1-Impact of output of different countries during 2005-2009

Table 1—Publication output and impact of different countries during 2005-2009

Country	Papers(P)		Citations(C)		CPP	RCI	Percentage of papers not cited
	(P)	P (%)	(C)	C (%)			
USA	16190	49.7	155236	62.1	9.6	1.2	20
UK	4307	13.3	50227	20.1	11.6	1.5	18
China	6253	19.2	27256	10.9	4.4	0.6	35
India	3042	9.3	10145	4.1	3.3	0.4	44
Brazil	2780	8.5	7161	2.8	2.6	0.3	53
Total	32574	100	250037	100	7.7	1.0	

Numerically:

$$\text{Computer based intelligence} = \{(N_{ij}/N_{io})/(N_{oj}/N_{oo})\} \times 100$$

N_{ij} : Number of distributions of the country I in a sub- strength j;

N_{io} : Number of distributions of the country I in every one of the sub-specialties;

N_{oj} : Number of distributions of every one of the five nations in a sub-forte j;

N_{oo} : Number of distributions of every one of the five nations in every one of the sub-specialties.

Here 'all' suggests the five nations considered.

Simulated intelligence = 100 demonstrates that a nation's examination exertion in the given field compares correctly to the world normal, $AI > 100$ reflects higher than normal movement, and $AI < 100$ shows below a normal exertion by the country.

The estimations of the action list have been determined for two unique periods i.e., 2005 and 2009 separately to inspect the change in accentuation during 2009 when contrasted with 2005. The consequences of the action record are given in Table 2. From the estimations of AI given in Table 2, it is seen that the circulation of AI is exceptionally slanted. There are a few nations that focus their examination exertion just on one sub-space, while different nations appropriate their exploration endeavors in more than one sub-area. For example, in 2005 USA had the most elevated movement in the sub- space of quantitative hereditary qualities/biometrics which moved to fertilization/mating framework in 2009. In any case, quantitative hereditary qualities/biometrics likewise stayed a high need territory in 2009 too. On account of the UK, the most noteworthy movement in 2005 was in cytology/cytogenetics which changed to pre- reproducing/germplasm and quantitative hereditary qualities/biometrics in 2009. For China, the exploration action redirected from hybridisation and transgenics/tissue culture to abiotic stress and quality articulation. Notwithstanding, marker-helped determination stayed the space of need in the two-time frames. For Brazil, the movement moved from varietal improvement/traditional reproducing, abiotic stress and marker-helped determination in 2005 to hybridisation, pre-rearing/germplasm and fertilization/mating framework in 2009.

On account of India, the significant examination zones were varietal improvement/regular reproducing to abiotic stress and marker-helped determination. Lately environmental change is the hot space of exploration. The raisers are focussing on the advancement of assortments reasonable for dampness stress condition and high-temperature resilience especially for winter yields like wheat and rabi beat. With the approach of sub-atomic marker innovation, Indian researchers have started sub-atomic markers-related works somewhat recently and made extraordinary progress in the yields like rice, wheat, maize and chickpea and so forth Indian analysts have started marker-helped determination and assortments have been created in rice (Improved Pusa Basmati 1; Improved Sambha Mahsuri), maize (Vivek QPM 9) and pearl millet (HHB67-2)6. Be that as it may, transgenics/tissue

culture stayed a space of examination need during 2005 just as in 2009.

The above investigation shows that the need continued moving from one sub-space in 2005 to the next in 2009 for every one of the nations. Scientometric profile of 'plant hereditary qualities and reproducing' research in India

Kind of archives distributed

During 2005-2009, a sum of 3,131 exploration things was distributed by Indian researchers. Of these, 2764 (88.3%) were research articles, 278 (8.9%) were survey papers and the leftover 2.8 percent were gathering continuing, meeting abstracts, publications, letters and remedies. Just 3042 records distributed as examination articles and audit papers have been exposed to a definite scientometric investigation. A crude examination of information demonstrates that the quantity of distributions developed fundamentally during 2008 and 2009 as about a portion of the all-out papers was distributed during these two years. Standard availability of Indian exploration yield

This perspective was analyzed by utilizing qualities of the diaries utilized for distribution, specifically the distribution in homegrown versus global diaries, the effect factor of the diaries utilized for imparting research results and the example of reference of the exploration yield.

Table 2—Change in activity profile of different countries in different sub-domains

Sub-domain	AI USA	AI A	AI UK	AI UK	AI China	AI China	AI India	AI India	AI Brazil	AI Brazil
	05	09	05	09	05	09	05	09	05	09
SD1: Abiotic stress	51	90	21	76	70	268	78	291	0	0
SD2: Hybridisation	108	83	90	85	144	107	77	56	72	126
SD3: Pre-breeding/germ plasm	104	115	97	158	64	78	79	113	47	211
SD4: Genetic evolution/mutation	113	111	113	120	84	77	70	55	87	69
SD5: Gene expression	103	92	92	90	119	128	97	74	31	42
SD6: Cytogenetics / cytology	101	87	134	106	88	93	96	87	104	66
SD7: Bio informatics	82	99	57	113	56	115	16	58	78	93
SD8: Pollination/mating system	100	127	82	85	119	94	47	95	88	144
SD9: Quantitative genetics / biometrics	134	118	90	130	80	49	110	26	69	93
SD10: Genetics / inheritance	106	105	59	70	56	97	53	57	110	50
SD11: Varietal improvement & conventional breeding	103	110	81	60	110	72	121	105	165	119
SD12: Molecular biology & genomics	100	94	112	86	106	102	106	100	75	78
SD13: Biotic stress	114	102	105	92	112	88	84	116	120	75
SD14 : Transgenics / tissue culture	101	75	117	66	139	121	217	181	93	67
SD15: Marker Assisted Selection	78	86	76	75	149	105	98	188	121	139
Sub-domains of highest priority	SD9	SD8 SD9	SD6	SD3 SD9	SD2 SD14 SD15	SD1 SD5 SD14	SD11 SD14	SD1 SD14 SD15	SD11 SD13 SD15	SD2 SD3 SD8
Sub-domains of highest activity during 2005-2009		SD9	SD3,SD4 and SD6		SD1,SD5, SD15		SD1, SD11, SD14,SD15		SD11 and SD15	

IV. DOMESTIC VS. INTERNATIONAL JOURNALS

Distributions from India in the field of 'plant hereditary qualities and reproducing' have showed up in 652 diary titles started in India and abroad. Of these, 611 diary titles began from abroad and 41 from India. The most noteworthy number of diary titles where Indian researchers distributed was from the USA. Investigation of the information for the dispersion of logical yield in homegrown and worldwide diaries introduced in Table 3 demonstrates that Indian researchers distributed around 20% of the examination papers in homegrown (Indian) diaries and the leftover 80%

papers in diaries distributed from abroad, in contrast to farming sciences, where a huge extent of papers were distributed in Indian journals. A conceivable justification for distributing less number of papers in Indian diaries may be the non-accessibility of well set up Indian diaries in the field of 'plant hereditary qualities and rearing'. Among the diaries distributed abroad, most extreme papers were distributed in diaries started from the USA, trailed by those distributed from the Netherlands and England.

About 58% of the papers distributed by Indian researchers showed up in diaries began from these three nations. It recommends that the exploration directed by India in the field of 'plant hereditary qualities and rearing' is distributed

in diaries beginning from the high- level nations of the West and as such very much associated with standard science. Informative supplement 2 records 24 most favoured diaries where Indian researchers have distributed 1% or more papers. Around 39% of the all-out papers were distributed in these 24 diaries. Of the 24 most favoured diaries, 9 were homegrown diaries and the rest were distributed from abroad.

Distribution of papers according to Impact Factor

Journal Impact Factor (JIF) is without a doubt, perhaps the most settled pointers used to assess the relative impact, significance or esteem of insightful diaries. It is the proportion of the quantity of references in the current year to the citable things distributed in the past 2 years. Papers showing up in diaries with high effect factor demonstrate standard readership and standard availability. During the previous many years, a few examinations had been distributed that applied diary sway factors and related reference measures to dissect the exploration execution of individual researchers, foundations and nations8.

The effect factor where the Indian scientists distributed their exploration papers was partitioned into four quartiles. The circulation of papers in every quartile has appeared in Table 4. Conveyance of yield as per the JIF gave in Table 4 shows that around 35% of the Indian exploration yield showed up in low IF diaries and the rest 65% in medium, high and exceptionally high effect factor diaries. This additionally proposes that the Indian exploration yield in the field of 'plant hereditary qualities and rearing' is universally obvious and very much associated with the standard science.

Table 3—Output of Indian scientists in domestic and foreign journals

Journal PublishingCountry	No. journals	No. of papers	% of papers
USA	179	625	20.5
India	41	622	20.4
Netherlands	83	607	20.0
England	165	536	17.6
Germany	36	155	5.1
Ireland	7	71	2.3
France	8	38	1.2
Nigeria	5	34	1.1
Australia	9	33	1.1
Japan	14	29	1.0
Others (37 countries)	105	292	9.6
Total	652	3042	100.0

Table 4—Distribution of papers according to impact factor

Quartile (Category and value of Impact Factor)	No. of papers	% of papers
Q1 (low, 0.87)	1007	35.1

Q 2 (Medium, 1.7)	736	25.6
Q 3 (High, 2.8)	598	20.8
Q 4 (Very high >2.8)	442	15.5
Total	2783*	100.0

*Number of papers was less than 3042 as many papers were published in journals whose IF was not available

Citation pattern of the research output

Effect factor examination is characteristic of the effect of the exploration yield, however may not be definitive because of innate impediments. To support its outcomes, reference examination was embraced as an additional measurement to consider the effect of the yield on the worldwide local area as a reference of distribution in the logical writing marks both quality and permeability. Quality papers are regularly referred to which thusly assists them with obtaining more prominent permeability and exposure in scholastic circles.

References were inspected for each paper for the time frame 2005 to 2009. The consequences of the reference examination show that 3,042 papers got 10,145 references in all during 2005-2009 (Table 5). The reference rate per paper for the Indian examination yield is 3.3. Further examination demonstrates that 44% of papers remained uncited. The extent of papers referred to between 1-5 times was 40% and the excess 16% were referred to in excess of multiple times. Of these, 7.5 percent of papers were referred to in excess of multiple times and just 2% of papers were referred to in excess of multiple times. Informative supplement 3 records papers which got at least 50 references. From this, it very well may be derived that the papers distributed by Indian researchers in the space of 'plant hereditary qualities and reproducing' exploration couldn't pull in high references from the worldwide local area. Deciding likely purposes behind this need further investigation. Be that as it may, of the 44% uncited papers, 83% were distributed during 2009 and

48% in 2008 which have a reasonable opportunity to be referred to in coming years, and may yield better reference results.

Distribution yield and effect of various performing areas

India is a country with an immense S&T framework. It involves in excess of 400 public labs under various logical associations like the Department of Science and Technology (DST), Department of Biotechnology (DBT), Council of Scientific and Industrial Research (CSIR), Indian Council of Medical examination (ICMR), Department of Atomic energy (DAE), and, Indian Council of Agriculture Research (ICAR). Logical exploration in India is likewise acted in scholastic establishments (colleges, considered colleges and universities) whose number surpasses 350 just as in 1300 perceived in-house modern units, a few government offices and private organizations and establishments. Table 6 shows the circulation of yield as indicated by various performing

areas that created 1% or a greater amount of the logical yield alongside their absolute references, RCI and CPP.

The information introduced in Table 6 shows that scholarly organizations are the biggest makers of logical yield in the field of 'plant hereditary qualities and reproducing' like the absolute Indian logical output¹⁰ and exploration yield in other fields¹¹. The distribution yield of scholarly establishments was trailed by the Indian Council of Agriculture Research (ICAR) and State Agriculture Universities and schools. These two together produced 28 percent of the total scientific output. ICAR with its 97 research institutes and 45 State Agricultural Universities is the nodal agency for carrying out research in the field of agriculture in general and 'plant genetics and breeding' research in particular and have played a major role in promoting 'plant genetics and breeding' research in India. The Council of Scientific and Industrial Research also contributed about 12 percent of the publication output. These four sectors together produced 79 percent of the total output. This indicates that the publication output is concentrated

among few performing sectors. The remaining 21 percent output came from other sectors listed in Table 6.

No. citations	of No. of papers	% of papers	Total citations
0	1335	43.9	0
1	468	15.4	468
2	296	9.7	592
3	178	5.9	534
4	143	4.7	572
5	127	4.2	635
6 -10	269	8.9	2062
11-15	107	3.5	1341
16-20	57	1.9	993
>20	62	2.0	2948
Total	3042	100.0	10145

Table 5—Frequency of citations of Indian research output during 2005-2009

Table 6—Publication output and impact of different performing sectors

Organizations	Total papers (%)	Total citations (%)	RCI	CPP
Academic Institutions	1173 (38.6)	3446 (34.0)	0.9	2.9
Indian Council of Agriculture Research (ICAR)	488 (16.0)	1808 (17.82)	1.1	3.7
State Agriculture Universities & colleges (SAUs)	376 (12.4)	733 (7.2)	0.6	1.9
Council of Scientific and Industrial Research (CSIR)	365 (12.0)	1405 (13.8)	1.2	3.8
International R&D institutions	130 (4.3)	883 (8.7)	2.0	6.8
Indian Institutes of Technology (IITs) and engineering colleges	76 (2.5)	326 (3.2)	1.3	4.3
Department of Atomic Energy (DAE)	73 (2.4)	298 (2.9)	1.2	4.1
Department of Biotechnology (DBT)	64 (2.1)	233 (2.3)	1.1	3.6
Department of Science and Technology (DST)	59 (1.9)	205 (2.0)	1.1	3.5
Ministry of Environment and Forests (MoEF)	48 (1.6)	98 (0.96)	0.6	2.0
Private R&D institutions	42 (1.4)	187 (1.8)	1.3	4.5
State Government R&D institutions	40 (1.3)	103 (1.0)	0.8	2.6
Others	108 (3.6)	420 (4.1)	1.1	3.9
Total	3042 (100)	10145 (100)	1.0	3.3

The remaining of various performing areas decided from the estimations of RCI demonstrates that worldwide R&D organizations situated in India had the most noteworthy (2.0) estimation of RCI like the 'hereditary qualities and heredity' research in India¹². This was trailed by private R&D organizations and Indian Institutes of Technology each having a RCI estimation of 1.3. Scholarly organizations, State Agriculture Universities and schools, Ministry of Forests and Environment and the R&D foundations under the State government had RCI < 1. This demonstrates that papers distributed by these four areas were referred to as not exactly the normal Indian papers. Not exactly 50% of the papers distributed by Indian researchers had a higher estimation of RCI than the Indian normal.

The estimation of CPP for India is 3.3. As the estimation of RCI, the estimation of CPP is likewise the most elevated (6.8) for global R&D organizations. Different areas having higher estimations of CPP than normal were ICAR, CSIR, IITs, DAE, DBT, DST and private R&D foundations. For the remainder of the performing areas recorded in Table 6, the estimation of CPP is not exactly the Indian normal.

Distribution yield and effect of productive foundations

The absolute yield of 3,042 distributions came from 1806 establishments dispersed in various pieces of the country. Be that as it may, among these 23 foundations distributed 1% or a greater amount of the papers. These 23 foundations contributed around 41% of the absolute Indian yield distributed by India during 2005-2009 and the leftover 59% distributions were contributed by 1783 establishments. Table 7 records 23 most productive establishments that contributed at least 30 papers alongside their distribution and reference markers. Of the 23 productive organizations, 12 were scholastic foundations and the rest had a place with CSIR (4), ICAR (3), DAE and DST every one and two were global establishments situated in India. Among the foundations recorded in Table 7, the most elevated commitment came from the Indian Agricultural Research Institute, New Delhi followed by the University Of Delhi and the National Botanical Research Institute, Lucknow.

Table 7—Indian Institutions publishing 30 or more papers during 2005-2009

Institute	Papers(P)	P (%)	Citations (C)	C (%)	CPP	RCI
Indian Agriculture Research Institute	167	5.5	1195	11.8	7.2*	2.1*
Delhi University	136	4.5	611	6.0	4.5*	1.4*
National Botanical Research Institute	91	3.0	349	3.4	3.8	1.2
Tamilnadu Agriculture University	83	2.7	279	2.8	3.4	1.0
Intern. Crops Research Institute of Semi Arid Tropics	80	2.6	364	3.6	4.6	1.4
Bhabha Atomic Research Centre	55	1.8	215	2.1	3.9	1.2
Punjab Agriculture University	53	1.7	85	0.8	1.6	0.5
Banaras Hindu University	49	1.6	157	1.6	3.2	1.0
Bose Institute	49	1.6	182	1.8	3.7	1.1
Aligarh Muslim University	43	1.4	168	1.7	3.9	1.2
Mysore University	42	1.4	104	1.0	2.5	0.7
CCS Haryana Agriculture University	41	1.3	64	0.6	1.6	0.5
Intern. Centre for Genetic Engg. & Biotechnology	38	1.2	488	4.8	12.8	4.0
Central Institute of Medicinal & Aromatic Plants	37	1.2	55	0.5	1.5	0.4
University of Agriculture Sciences (Bangalore)	37	1.2	136	1.3	3.7	1.1
Central Food Technology Research Institute	35	1.2	143	1.4	4.1	1.2
Hyderabad University	34	1.1	131	1.3	3.9	1.2
National Chemical Laboratory	34	1.1	125	1.2	3.7	1.1
Indian Institute of Science	32	1.1	196	1.9	6.1	1.7
Bharathidasan University	31	1.0	53	0.5	1.7	0.5
Calcutta University	31	1.0	101	1.0	3.3	1.0
Institute of Himalayan Bioresource Technology	31	1.0	77	0.8	2.5	0.8
National Bureau of Plant Genetic Resources	30	1.0	66	0.7	2.2	0.7
Others	1783	58.6	4801	47.3	2.7	0.8
Total	3042	100.0	10145	100.0	3.3	1.0

*Indian Agriculture Research Institute, New Delhi and University of Delhi, Delhi has higher values of RCI and CPP, because these two institutions had a collaborative paper which was cited more than 700 times.

Impact of the research output of these institutions has been examined by using the same indicators as has been used for measuring the performance of five different countries and performing sectors above. Of the 23 prolific institutions listed in Table 7, RCI was higher than 1 for 12 foundations and was most noteworthy (4.0) for the International Center for Genetic Engineering and Biotechnology, New Delhi, trailed by the Indian Institute of Science (1.7), the International Crop Research Institute for Semi-Arid and Tropics, and the University of Delhi each 1.4. This infers that papers distributed by these foundations were referred to more than the normal Indian papers. The normal estimation of CPP like the RCI was higher than the normal for 13 organizations. Like the estimation of RCI, International Center for Genetic Engineering and Biotechnology, New Delhi additionally had the most elevated CPP (12.8). The estimation of RCI is under 1 for the greater part of the State Agriculture Universities including the Central Institute of Medicinal and Aromatic Plants. The estimation of CPP is likewise not exactly the Indian normal for these organizations. A crude investigation of information demonstrates that these establishments distributed their exploration brings about low effect factor diaries and subsequently were less referred to, which brought about low estimations of CPP and RCI.

Coordinated effort example of Indian researchers

Science is not, at this point a quest for a person. Governments in various nations have taken activities to upgrade contacts among researchers in science through synergistic exploration programs, both at the public and global levels. Such activities have brought about expanded joint effort at public and global levels. Different explanations behind the joint effort have been recorded by Beaver13. In the current examination, the pattern of coordinated effort has been inspected into two unique ways i.e., change in the example of co- origin during 2005-2009 and the example of worldwide cooperation during 2005-2009. Change in the example of co-creation during 2005-2009

Table 8—Pattern of co-authorship Index during 2005-2009

Year	Single authored papers (CAI)	Two authored papers (CAI)	Multi authored papers (CAI)	Mega authored papers (CAI)	Total
2005	22 (129)	85 (92)	201 (97)	154 (74)	462
2006	23 (119)	98 (93)	227 (96)	179 (76)	527
2007	31 (136)	132 (107)	276 (100)	179 (65)	618
2008	21 (80)	152 (106)	332 (104)	210 (66)	715
2009	15 (57)	142 (99)	328 (102)	235 (73)	720
Total	112	609	1364	957	3042

Table 9—Distribution of domestic and international co-authored papers

Year	Domestically co-authored papers	Internationally co-authored papers (%)	Total papers
2005	371	91 (19.7)	462
2006	413	114 (21.6)	527
2007	507	111 (17.9)	618
2008	583	132 (18.5)	715
2009	594	126 (17.5)	720
Total	2468	574 (18.7)	3042

To quantify how the example of co-creation have changed during 2005-09, creators utilized the Co- origin Index (CAI) recommended by Garg and Padhi¹⁴ and utilized by Guan and Ma¹⁵ in their investigation on software engineering. CAI is determined in a manner like AI. For this reason, papers were partitioned into four classifications. These were single-wrote papers, two composed papers, multi-created papers having 3 or 4 creators and mega wrote papers having multiple creators. The consequences of CAI given in Table 8 demonstrate that the estimation of CAI for single- created papers has gone down extensively from 129 out of 2005 to 57 of every 2009. The estimation of CAI for two composed and multi-wrote papers have expanded imperceptibly in the later period, which demonstrates an expanding pattern towards multi- created papers.

Example of global coordinated effort during 2005-2009 Indian researchers distributed 574 papers in a global joint effort with 70 unique nations. Of these, the most noteworthy number of worked together papers was with the USA (153) trailed by Germany (71) and South Korea (54). Other teaming up nations having in excess of 20 papers in cooperation were Australia (43), UK (41), France (34), China and Japan 33 every, Philippines (25), and Mexico and Israel 21 each. Staying 59 nations had 45 teamed up papers. Table 9 presents the conveyance of locally and universally co-created papers during 2005-2009. From the information introduced in Table 9, it is seen that the extent of universally co-wrote papers drifted around 18% during the whole time of study besides in 2006, when the extent of globally co-created papers rose to ~ 22%.

V. CONCLUSION

Scientometrics as an innovation gauging apparatus distinguishes arising logical regions and helps in checking

early signals of new mechanical improvements via looking through the writing. The examination analyzed the example of yield, effect and shift in an accentuation of exploration in regard of the USA, the UK, China, and Brazil with uncommon accentuation on India. On account of India, the examination recognized various organizations engaged with research around here, the correspondence and reference example of the exploration yield, exceptionally beneficial foundations and the effect of their exploration yield. The investigation shows a consistent and steep ascent in the distribution yield for China during 2005-2009 and balanced out research yield for India during 2008- 2009. Albeit, the USA had the most noteworthy distribution yield however the UK had the most noteworthy effect. China betterly affected exploration yield than India. All nations moved their accentuation to more up to date sub-spaces in 2009. The papers distributed by Indian researchers seem, by all accounts, to be all around associated with standard science. The scholastic establishments, the Indian Council of Agriculture Research and the Council of Scientific and Industrial Research are the significant supporters of the exploration yield. Worldwide R&D foundations situated in India betterly affected examination than their Indian partners. The idea of exploration work has moved from singular examination to cooperation and universally co-created papers have remained practically consistent during the time frame under investigation.

The assessment examined the case of yield, impact and shift in a highlight of investigation in respect of the USA, the UK, China, and Brazil with exceptional emphasis on India. Because of India, the assessment perceived different associations related with research around here, the correspondence and reference illustration of the investigation yield, incredibly productive foundations and the impact of their investigation yield.

REFERENCES

- [1] Beintema N, Adhiguru P, BIRTHAL P S, and BAWA A K, Public agricultural research investments: India in a global context, Available at http://www.ncap.res.in/upload_files/policy_brief/pb27.pdf (Accessed on 24 December 2010)
- [2] Kumari G L, Synthetic organic chemistry research: Analysis of scientometric indicators, *Scientometrics*, 80(2009) 559-570.
- [3] Frame J D, Mainstream research in Latin America and Caribbean, *Interciencia*, 2 (1977) 143-148.
- [4] Schubert A and Braun T, Relative indicators and relational charts for comparative assessment of publication output and citation impact, *Scientometrics*, 9 (1986) 281- 291.
- [5] Gupta P K, Kumar J, Mir R R, and Kumar A, Marker-Assisted Selection as a Component of Conventional Plant Breeding, (in) *Plant Breeding Reviews*, Volume 33 (ed J. Janick), John Wiley & Sons, Inc., Hoboken, NJ, USA, 2010.
- [6] Garg K C, Kumar S and Lal K, Scientometric profile of Indian agricultural research as seen through Science Citation Index expanded, *Scientometrics*, 68 (2006) 151- 166.
- [7] Moed H F, *Citation Analysis in Research Evaluation*, Springer, Heidelberg, 2005
- [8] Goldfinch S, Dale T and De Rouen K, The science from the periphery: collaboration, networks and periphery effects in the citation of New Zealand Crown Research Institute articles, 1995-2000, *Scientometrics*, 57(2003) 321-337.
- [9] Garg K C, Dutt B and Kumar S, Scientometric profile of Indian science as seen through Science Citation Index, *Annals of Library and Information Studies*, 53 (2006) 114- 125.
- [10] Dutt B, Kumar S and Garg K C, Mapping of plant-based medicine research in China and India, *Research Evaluation*, 18 (2009) 51-59.
- [11] Garg K C, Kumar S, Dutt B and Chakraborty O, Scientometric profile of genetics and heredity research in India, *Annals of Library and Information Studies*, 57 (3) (2010) 196-206.
- [12] Beaver, D. Reflections on scientific collaboration (and its studies): Past, present and future, *Scientometrics*, 52(2001) 365-377.
- [13] Garg K C and Padhi P, A study of collaboration in laser science and technology, *Scientometrics*, 51(2001) 415- 427.
- [14] Guan J C and Ma N, A comparative study of research performance in computer science, *Scientometrics*, 61(2004) 339-359
- [15] Acquaah G, *Principles of plant genetics and breeding*, Wiley Blackwell, USA, 2006